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## The Change of Climate in the British Isles

A recent inquiry led to the extraction of some figures dealing with the climate of the British Isles in the two periods 1851-1900 and 1901-30, and the results appear to be of sufficient interest to be put on record. Briefly, the second period has been appreciably more "oceanic" than the first, with higher winter temperatures, a smaller annual range of temperature and on the whole a greater rainfall, especially in the winter months.

The average temperatures and rainfalls of the two periods month by month at Greenwich, Oxford and Edinburgh are shown in table I. The winter months (December, January and February) in 1901-30 were all warmer than the corresponding months in 1851-1900, the average differences being  $1.2^{\circ}$  F. at Greenwich and  $0.8^{\circ}$  F. at Oxford and Edinburgh. On the other hand the summer months (June, July and August) were all cooler in the second period, the average differences being  $0.7^{\circ}$  F. at Greenwich and  $0.4^{\circ}$  F. at Oxford and Edinburgh. Another interesting point is that in the first period January was decidedly the coldest month, while in the second, February was slightly colder than January at all three stations. This retardation of the winter minimum is also characteristic of an oceanic climate. The difference between the averages of the warmest and coldest months has decreased by  $2.0^{\circ}$  F. at Greenwich,  $1.3^{\circ}$  F. at Oxford and  $1.4^{\circ}$  F. at Edinburgh. These changes, though small are quite appreciable. Similar changes occurred at Aberdeen

during the period 1870-1932, which has been studied in detail by A. E. M. Geddes,\* whose results point to a rise in the mean temperature for the six months December to May, to no change in the period June to August, and, for the remaining three months, to a maximum having been passed between 1908 and 1916, and to a decline having set in, though that decline has been temporarily arrested.

TABLE I.—TEMPERATURE AND RAINFALL, 1851-1900 AND 1901-30

	Temperature.						Rainfall.					
	Greenwich.		Oxford.		Edinburgh.		Greenwich.		Oxford.		Edinburgh.	
	1851-1900.	1901-30.	1851-1900.	1901-30.	1851-1900.	1901-30.	1851-1900.	1901-30.	1851-1900.	1901-30.	1851-1900.	1901-30.
	°F.	°F.	°F.	°F.	°F.	°F.	in.	in.	in.	in.	in.	in.
January ..	38.7	40.3	38.5	39.7	38.0	39.2	1.95	1.87	2.15	2.16	2.09	2.08
February ..	39.6	40.2	39.5	39.6	38.7	39.1	1.45	1.64	1.58	1.71	1.68	1.73
March ..	41.7	42.7	41.3	42.2	42.5	41.0	1.50	1.77	1.51	1.88	1.68	1.84
April ..	47.4	46.7	46.8	46.0	44.9	44.4	1.56	1.81	1.56	1.93	1.49	1.53
May ..	53.1	54.0	52.0	53.3	49.7	49.5	1.88	1.80	1.84	1.98	1.90	2.13
June ..	59.5	58.3	58.4	57.7	55.6	54.8	2.02	2.07	2.33	2.03	2.31	1.77
July ..	62.7	62.2	61.5	61.3	58.5	58.2	2.42	2.45	2.49	2.52	2.76	2.63
August ..	61.8	61.3	60.6	60.2	57.8	57.6	2.27	2.41	2.39	2.33	3.00	3.40
September ..	57.3	57.1	56.2	56.0	53.9	53.9	2.17	1.81	2.32	1.86	2.47	2.19
October ..	50.5	50.8	49.1	49.8	47.3	48.3	2.75	2.30	2.78	2.74	2.44	2.79
November ..	43.3	43.5	42.7	42.7	41.7	42.3	2.20	2.35	2.21	2.28	2.29	2.10
December ..	39.8	41.2	39.4	40.5	38.8	39.7	1.87	2.49	1.95	2.78	2.31	2.31
Year ..	49.6	49.9	48.8	49.1	47.3	47.3	24.04	24.77	25.11	26.20	26.42	26.50

Owing to the lack of long-period stations the changes from 1851 to 1930 cannot be followed in detail over the British Isles. A fair number of stations have homogeneous records since 1871 however, and from these it is possible to calculate the approximate changes for the various climatological districts. These are set out in Table II. It will be seen that the increase of temperature in winter was greatest in eastern, central and southern England and northern Ireland, while the decrease in summer was greatest in northern and eastern Scotland and eastern England.

The average annual rainfalls at Greenwich, Oxford and Edinburgh, given in Table I, all show a slight increase in 1901-30 over 1851-1900, but the increase exceeds an inch only at Oxford. The differences change irregularly from one month to another, but the

\* *London, Q.J.R. Meteor. Soc.*, 61, 1935, pp. 347-56.

averages for the different seasons for 1901-30 are greater than for 1851-1900 in winter and spring and smaller in autumn at all three stations, while summer shows an increase at Greenwich and a

TABLE II.—MEAN TEMPERATURE DIFFERENCES, 1901-30 MINUS 1871-1900

	<i>Winter.</i>	<i>Spring.</i>	<i>Summer.</i>	<i>Autumn.</i>	<i>Year.</i>
Scotland, N. ...	+0.5	-0.1	-0.7	-0.1	-0.1
Scotland, E. ...	+0.6	-0.1	-0.7	0.0	0.0
Scotland, W. ...	+0.6	+0.1	-0.3	+0.2	+0.2
England, N.E. ...	+0.8	+0.3	-0.7	+0.1	+0.1
England, E. ...	+1.2	+0.5	-0.8	+0.2	+0.3
Midlands ...	+1.2	+0.9	-0.1	+0.5	+0.6
England, S.E. ...	+1.1	+0.7	-0.4	+0.3	+0.4
England, N.W. ...	+0.8	+0.3	-0.5	+0.3	+0.2
England, S.W. ...	+0.9	+0.5	-0.2	+0.4	+0.4
Ireland, N. ...	+1.2	+0.4	-0.3	+0.6	+0.5
Ireland, S. ...	+0.5	-0.2	-0.5	+0.1	0.0
Mean... ...	+0.9	+0.3	-0.5	+0.2	+0.2

decrease at Oxford and Edinburgh. It is a curious feature of Table I that the changes of both temperature and rainfall at Oxford resemble those at Edinburgh far more than those at Greenwich, although the latter station is so much nearer to Oxford.

Similar features are shown by the average rainfall for England and Wales as a whole.\* The seasonal averages are shown in Table III.

TABLE III.—RAINFALL FOR ENGLAND AND WALES

	<i>Winter.</i>	<i>Spring.</i>	<i>Summer.</i>	<i>Autumn.</i>	<i>Year.</i>
A. 1851-1900 (in.)	9.52	6.75	8.91	10.65	35.83
B. 1901-30 (in.) ...	10.34	7.50	8.89	10.03	36.76
B/A per cent. ...	109	111	100	94	103

The greatest increase has occurred in December, for which month the average rainfall of 1901-30 was 126 per cent. of that of 1851-1900. The greatest decrease was in September, the ratio being only 82 per cent.

It is natural to look for the immediate cause of this change of climate in a change in the distribution of pressure and winds. Table IV shows the average pressure at Greenwich and the pressure differences between Greenwich and Valentia (east-west) and between Greenwich and Aberdeen (south-north) for the periods 1871-1900 and 1901-30.

It will be noticed that in winter and to a less extent in spring, not only was the average pressure lower in the second period than in the first, but the gradients were also appreciably greater, indicating the more frequent passage of barometric depressions and stronger and steadier SW. winds. In summer on the other hand, pressure was

\* *British Rainfall*, 1931, pp. 303-4.

higher in the second period than in the first but the gradients are practically the same. For the year as a whole the figures show little change.

Pressure data for Valentia and Aberdeen are not available back to 1851. Wind data for London and Edinburgh exist for the whole

TABLE IV.—PRESSURE DISTRIBUTION, 1871–1900 AND 1901–30

	Greenwich.		Greenwich- Valentia.		Greenwich- Aberdeen.	
	1871- 1900.	1901- 30.	1871- 1900.	1901- 30.	1871- 1900.	1901- 30.
	mb.	mb.	mb.	mb.	mb.	mb.
Winter ...	1015.8	1014.8	+2.5	+2.8	+5.6	+6.2
Spring ...	1014.5	1014.1	+0.3	+0.5	+1.8	+2.2
Summer ...	1015.2	1015.7	0.0	-0.3	+2.5	+2.6
Autumn ...	1014.4	1015.0	+0.9	+1.4	+3.9	+3.7
Year ...	1015.0	1014.9	+0.9	+1.1	+3.4	+3.6

period, however, and for Dublin for most of it. These were converted into resultant direction (in degrees from north) and "constancy",\* the latter term representing the vector sum of the winds, giving unit value to each observation irrespective of force, expressed as a percentage of the total number of observations. The results are shown in Table V. In winter the prevailing direction is between SW. and W. at all stations in both periods; there has been little

TABLE V.—WIND DIRECTION AND CONSTANCY

	Winter.		Summer.		Year.	
	Direction.	Constancy	Direction.	Constancy	Direction.	Constancy
London—	°	%	°	%	°	%
1851–1900	226	26	242	28	235	19
1901–30	229	31	250	26	239	21
Edinburgh—						
1851–1900	248	40	265	24	257	26
1901–30	229	46	266	26	241	30
Dublin—						
1851–1900	242	40	270	24	262	25
1901–30	237	51	278	32	256	17

\* London, *Q.J.R. Meteor. Soc.*, 59, 1933, p. 384.

change of direction, but the "constancy" of the wind has increased by from 5 to 11 per cent. This increase in the frequency of winds from WSW. readily accounts for the greater warmth and heavier rainfall of the winter months. In summer on the other hand, there has been little change in the "constancy", but the prevailing direction was slightly more northerly in the second period. Thus the change of climate between the periods 1851-1900 and 1901-30 is in general accordance with the change in the pressure and winds.

C. E. P. BROOKS.

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## OFFICIAL PUBLICATION

### PROFESSIONAL NOTES

No. 68. *Some notes on readings at Kew Observatory of the Gorczynski pyrhelimeter, the sunshine recorder and the black-bulb thermometer.* By H. L. Wright, M.A. (M.O. 336h.).

The Gorczynski pyrhelimeter is an instrument designed to give continuous registration of the intensity of solar radiation, and the results of a review of the records obtained between July and November, 1927, from a Gorczynski pyrhelimeter installed at Kew Observatory are given in this paper. The relation between the daily aggregate of radiation recorded by the Gorczynski instrument and the daily duration of sunshine registered by the Campbell Stokes recorder both under the most favourable conditions, that is, when atmospheric absorption is at a minimum, and under average conditions is worked out, as well as the relation between the rate of radiation recorded by the pyrhelimeter and the width of the burn recorded simultaneously on the sunshine card.

The paper ends with a short comparison between the daily readings of the black-bulb thermometer and the maximum rate of radiation registered each day by the pyrhelimeter.

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## Correspondence

To the Editor, *Meteorological Magazine*

### Green Clouds seen from Edinburgh

On July 10th, 1935, at about 8.15 p.m. B.S.T., or quite two hours before sunset, looking north-westward from the garden of No. 16, West Savile Road, Edinburgh, 9, I witnessed an unusually striking and beautiful sight.

Over the roof-tops of adjoining houses were visible snow-white cirrostratus clouds, tinted here and there with vivid green, and an occasional marginal tinge of orange; atmosphere clear, sky background a brilliant blue. The clouds being at an altitude of about fifteen degrees, were well clear of the housetops, but sun and horizon were shut out from view. Thus though I mentally connected the

phenomenon with the green flash, I could not say if there were any flash in evidence lower down, either then or later.

About 9.15 p.m. the same clouds, slightly lower down, were lit up with the crimson glow of a beautiful sunset.

Since noting the foregoing I have wondered if what appeared to be patches of green cloud are capable of explanation as resulting from filtration of the intense blue of the sky background through bands of yellow sunlight across unnoticed gaps in the clouds. If so, the marginal orange tints would also be explained, the background in this case being white; but as this did not occur to me at the time, I am unable now to recall the picture with sufficient accuracy to be certain about it.

T. C. SKINNER.

Reigate, July 30th, 1935.

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### Segment of Greyish Light

From about 13h. to 19h. G.M.T. a segment (about  $12^{\circ}$  to  $15^{\circ}$  above the horizon at vertex) of pale greyish light was seen on the north to eastern horizon. Like the rainbow this was directly opposite the sun. Following the apparent motion of the sun, the segment remained clearly visible until a point due east was reached at 19h. The phenomenon had then become much fainter and as the sun's altitude above the horizon decreased it gradually disappeared. The segment was wide in extent.

S. M. JAMESON.

Butterwick, Barton-le-Street, Malton, August 2nd, 1935.

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### Strange Sunset Effect

At 20h. 45m., G.M.T., on June, 24th a phenomenon similar to that described by Mr. W. L. Baxter, in the *Meteorological Magazine*, 69, 1934, p. 119, was witnessed here. Four delicate pink bands were seen radiating from the north-west not far from where the sun had set about 25 minutes previously. The bands were traceable right across the sky to the south-east where a cumulonimbus had developed during the evening. The two outer bands were very broad; the two inner ones parallel with each other, narrow, and inclined to the left. The spaces between the bands were clear and of the ordinary colour of the evening sky after sunset. The general appearance of the sky at the time was cloudless with the exception of the remains of the cumulonimbus which had almost broken up. This cloud was very pink, especially the hard summits of the cumuli on the south-eastern horizon. The phenomenon vanished by 21h. The surface wind was NE. moderate, and the temperature  $70^{\circ}$  F.

A. E. MOON.

39, Clive Avenue, Clive Vale, Hastings, June 27th, 1935.

### The Green Flash

When travelling in the Shetland-Orkney mail steamer on June 19th, 1935, I had a very good view of the "green flash" at sunset, approximately at 21h. 35m. G.M.T. In the south-west quadrant of the sky were visible cirrus and cirrostratus clouds, forerunners of the occlusion which passed over the Orkneys during the following afternoon, but towards north-west the sky was cloudless and the sun set behind a clear sea horizon.

The interesting point is that the colour of the "flash" was a vivid blue, not emerald green, as usually described. The actual colour of the "flash" under comparable conditions of temperature lapse probably depends on the amount of atmospheric pollution, in this case practically nil. The temperature of the air was probably only slightly, say  $1^{\circ}$  or  $2^{\circ}$  F., higher than that of the sea,\* but direct observations of the temperature are not available.

A point which I cannot find quoted in the literature available here is the momentary appearance, between the first red colour of the sun's limb and the blue flash, of a silvery white or almost neutral tint, possibly a colour illusion due to contrast. I may mention, however, that I tried to avoid retinal fatigue for red by refraining from continuous view of the red until the last few moments of the sunset.

S. T. A. MIRRELES.

*Meteorological Station, No. 1 F.T.S., Leuchars, Fife, July 6th, 1935.*

### World Weather and Solar Activity

In the recent review of my paper on "World Weather and Solar Activity," by C. E. P. Brooks, he points out that if positive correlations are found at any station between excess solar radiation and weather, then negative correlations should be found for defect in solar radiation even though the values are divided into six classes. This implies that if positive correlation is found for any one class then negative correlations should be found in the opposite condition of solar radiation for every other class. This criticism seems well taken but it so happens that I tested this relation between two classes of different values and did not get any appreciable correlation. The negative correlation came out distinctly when I made the comparison between classes having the same mean departure from normal.

With this explanation, which should probably have been included in the text, the fact that there was in most cases a fairly large correlation between stations in the same class still seems to me to indicate a real and not an accidental relation.

H. H. CLAYTON.

1410, Washington Street, Canton, Mass., U.S.A., June 3rd, 1935.

\* cf. note by R.W. Wood, quoted by Sir Napier Shaw, in "Manual of Meteorology", Vol. III. p. 68.

### Rain in Advance of True "Warm-front" Rain

With reference to Col. Gold's note on "Rain in advance of true warm-front rain", published in the *Meteorological Magazine* for November, 1934, my experience at Worthy Down during the years 1927-31, was that light rain before true warm-front rain was not uncommon and was frequently not confined to the few drops which, as Col. Gold remarks, are usual in these conditions. I do not remember, however, any occasion on which there was an interval of so long as two hours between the pre-frontal and true-frontal rain. I have notes of pre-frontal rain being conspicuous on September 29th, 1927, January 12th, 1928, June 8th, 1928, and December 2nd, 1929, but the interval was of the order of half-an-hour to one hour with the pre-frontal rain lasting about half-an-hour or rather less. On June 8th, 1928, the true warm-front rain commenced at 20h. 45m. G.M.T. and on December 2nd, 1929, it commenced at 9h. G.M.T. I am not in a position to check up my facts by reference to the *British Daily Weather Report*. There are not, so far as I am aware, any references to the occurrence of rain before continuous warm-front rain in the Middle East Area. There is, however, evidence that at Amman on December 5th, 1934, pre-frontal rain occurred from 9h. 20m. to 10h. G.M.T., the true warm-front rain not commencing until 11h. 20m. G.M.T.

C. V. OCKENDEN.

R.A.F., Heliopolis, Egypt. January 31st, 1935.

[The four cases mentioned by Mr. Ockenden have been examined by reference to the synoptic charts to obtain evidence regarding the magnitude of the pre-frontal rain and the time interval before the true-frontal, continuous rain area approached.

*September 29th, 1927.*—A shallow depression had formed on an occlusion which at 7h. G.M.T. lay along the line Eskdalemuir-Holyhead-St. George's Channel, and at the same time the forward edge of the frontal rain extended approximately from Portland to Leafield and Harrogate.

At South Farnborough slight rain occurred between 6h. and 7h. and by 7h. a trace was measured. At Worthy Down slight rain began between 5h. and 6h. and 1 mm. had been measured by 7h. G.M.T. The Beaufort letters recorded were  $r_0$ , and pr. Both of these must have been cases of pre-frontal rain with a time interval of one to two hours before the true-frontal rain.

*January 12th, 1928.*—A depression having a well-marked warm sector was travelling north-east with its centre passing a little west of Stornoway. At 13h. G.M.T. the forward edge of the true-frontal rain lay along the line Plymouth to the Wash.

Pre-frontal rain was reported from most stations in south-east and east England, the respective times of commencement being shown below :—



Worthy Down ...	...	...	$r_0$	began at 11h.
South Farnborough ...	...	...	$d_0$	" " 12h. 30m.
Kew ...	...	...	$r_0$	" " 12h. 30m.
Croydon ...	...	...	$r_0 r_0$	" " 9h.
Shoeburyness ...	...	...	$r_0$	" " 13h. 30m.
Clacton ...	...	...	$r_0$	" " 13h. 30m.

In this case the time interval ahead of the true warm front would be one to three hours.

*June 8th, 1928.*—A depression approached Valentia from the south-west and a wide band of warm-front rain was associated with it. At 1h. the forward edge of the true warm-front rain lay along the line Guernsey-Plymouth-near south coast of Ireland.

It is very difficult from the synoptic chart to decide regarding any pre-frontal rain on account of the small number of observations available at 1h. The rain area was not continuous and the time interval between the frontal and pre-frontal rain is doubtful.

*December 2nd, 1929.*—An intense depression was centred near south-west Iceland and there was a wide band of warm-front rain. At 7h. the forward edge of the true-frontal rain lay along the line Guernsey-Worthy Down-Sealand. Pre-frontal rain occurred at South Farnborough between 5h. and 6h. and 0.1 mm. was recorded by 7h. The time interval between pre-frontal and frontal rain was between one and two hours.—R. S. READ.]

## NOTES AND QUERIES

### Floods and Heavy Rain in Transjordan

The photograph reproduced as the frontispiece to this number of the magazine, which was taken by a Royal Air Force official on February 6th, 1935, shows the floods in the Jordan Valley near Allenby Bridge resulting from the heavy rain of the previous few days.

Towards the end of January a low pressure area was moving eastwards from Italy to Transcaucasia and at 7h. on the 31st, was centred to the south of the Black Sea. At Amman on that day the wind was WSW., force 6-7 until 14h. after which it decreased to force 4-5. Much cloud developed rapidly from 15h. and heavy continuous rain set in at 15h. 50m. continuing until 20h. 40m. During the next two days pressure remained low to the north and east and the winds SW. to W., force 4-6, with moderate rain. On the 3rd a secondary to the deep depression over northern Europe passed across Transjordan and more than 55mm. (2.1 in.) of rain were recorded. This was followed the next morning by a thunder-storm between 8h. 50m. and 9h. 15m. accompanied by hail and slight snow. Later on in the day pressure rose and anticyclonic conditions were established again by the 5th.

Temperature was low during the passage of this low pressure

area, a maximum of 44° F. being recorded on the 4th. The rainfall amounts measured each day were :—

Jan. 31st, 32.0 mm. (1.26 in.). Feb. 3rd, 55.7 mm. (2.19 in.).

Feb. 1st, 22.4 mm. (0.88 in.). Feb. 4th, 26.5 mm. (1.04 in.).

Feb. 2nd, 16.3 mm. (0.64 in.).

making a total at Amman for the five days of 153 mm. (6.02 in.) which is 9 mm. more than the combined total average rainfall for the months of January and February.

The rainfall for Transjordan generally was heavy for these five days and Ramleh, Palestine had 84.6 mm. (3.33 in.) during this period. Heavy rain, however, was not experienced in Iraq or Egypt except locally on the 3rd when Shaibah had 32.8 mm. (1.29 in.) and Aboukir 16.3 mm. (0.64 in.).

### Forecasting Weather from height of Barometer and Temperature of Wet Bulb

The mean results of the readings of the wet bulb thermometer and barometer at 7h. given in Lieut. Comdr. T. R. Beatty's table in the March issue of the *Meteorological Magazine* have been plotted by me on the accompanying diagram, where "the percentage numbers of cases of no rain" are ordinates and the barometer readings in millibars are abscissæ. The approximate slopes are shown in thicker lines which converge on 1007 mb. making it possible to obtain the common formula :—"the percentage number of cases of no rain" =  $C$  (mb.—1007) in which the values of  $C$  are 0.83 for F° above 48; 1.28 for 44–48 F°; 1.63 for 39–43 F° and 2.97 for F° below 39. The additional constants shown in the table in the diagram have been interpolated from another diagram not reproduced here.

Although the formula devised by me from Lieut. Comdr. Beatty's data can only be claimed to be a rough approximation it may serve a useful purpose in providing a figure value which taken at intervals of an hour or more may indicate the rate of change of the weather at any one place. This type of formula may be applicable to other stations although the critical barometric pressure (1007 mb.) and the constants are likely to vary especially inland.

If a similar relationship is established elsewhere it does not appear to be worth while to make a special instrument for the purpose as the estimation is simple enough to meet the need of "the man in the street" who can read a wet bulb thermometer and a barometer.

H. G. LLOYD.

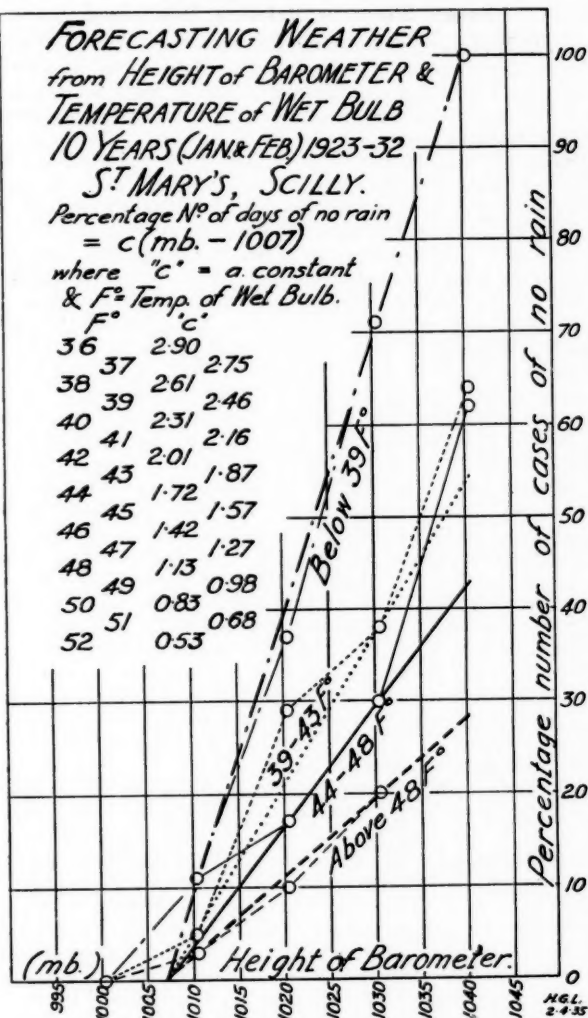
[I think Mr. Lloyd's result is an interesting one. It applies when the barometer is above 1007 mb. Clearly his "constant"  $C$  is a function of the wet-bulb temperature,  $T'$ . Approximately it is  $15/(T'-32)$  so that the percentage number of cases of no rain may be represented by  $P$  when  $P = 15 \frac{B-1007}{T'-32}$  or in words "the excess of the pressure (barometer) above 1007 mb. divided by the

# FORECASTING WEATHER from HEIGHT of BAROMETER & TEMPERATURE of WET BULB 10 YEARS (JAN & FEB) 1923-32 ST. MARY'S, SCILLY.

Percentage N<sup>o</sup> of days of no rain  
=  $c(\text{mb.} - 1007)$

where "c" = a constant  
&  $F^{\circ}$  Temp. of Wet Bulb.

36	2.90
37	2.75
38	2.61
39	2.46
40	2.31
41	2.16
42	2.01
43	1.87
44	1.72
45	1.57
46	1.42
47	1.27
48	1.13
49	0.98
50	0.83
51	0.68
52	0.53



excess of the wet-bulb temperature above 32°F. and multiplied by 15 gives the percentage probability of no rain (at Scilly) in the next 24 hours in January and February". It would be interesting to see if similar results applied to other months at Scilly and to other places.—E. GOLD.]

### Severe Storm at Mafeteng, Basutoland

Mr. D. E. Millichamp of Mafeteng, Basutoland, has sent the following notes of a severe storm which passed over Mafeteng on January 3rd, 1935, when 1·50 in. of rain fell in 30 minutes. Such heavy rain has not been experienced there since February 18th, 1931, when 1·60 in. fell in 90 minutes.

During the last six days of December, 1934, the wind was from NW., but on the 31st there was a change to SSW. force 2 increasing somewhat during the day and with a further change to S. force 4 by 8h. 30m. on January 1st, when the relative humidity was as low as 25 per cent. Day temperature began to increase from December 30th, 82° F. being recorded on the 31st, 85° F. on the 1st and 86° F. on the 2nd, the highest screen temperature so far this summer. On the 2nd and early on the 3rd the wind was N. force 4 and the relative humidity increased to between 40 and 50 per cent., while the sky was clear at the hour of observation, 8h. 30m., on the 2nd but was  $\frac{3}{10}$  covered with altocumulus on the 3rd at the same time. At 12h. 30m. on the 3rd the cloud changed to cumulus and increased to  $\frac{6}{10}$  coming from the north-west. The wind also increased to force 5 from NW. by 14h., by which time the sky was overcast and the temperature had risen to 82° F.; a minute or so later a few large spots of rain fell and a rapid cooling was noticeable. At 14h. 30m. the wind had increased to force 6 from NW. and the cloud changed to mammatocumulus while, owing to dust which was now blowing along in clouds, visibility had lessened to 6 $\frac{1}{4}$  miles. The dust storm continued until 15h. 30m. when rain commenced to fall very heavily. "By this time the temperature had fallen to 72° F. and the wind increased to force 7. At 15h. 37m. hail commenced to fall, thick and very white and of the size of large fresh peas somewhat oval in shape. Hail fell for 3 minutes only and quickly melted. Thunder was heard, but flashes of lightning were not seen well owing to visibility having lessened to 220 yds. By 15h. 45m. the temperature had fallen to 51° F. Wind now began to lessen in force, but rain continued heavily until at 16h. one was able to approach the rain-gauge, the force of the storm having lessened. At this hour rain was measured and found to be 1·50 inches so that in the space of 30 minutes, 151 $\frac{1}{2}$  tons of water had fallen per acre. Rain continued to fall until 20h. 40m., when the remainder was measured and the total fall found to be 1·61 in. Visibility had increased to 12 $\frac{1}{2}$  miles at 16h.", by which time too the temperature had risen to 57° F.—59° F. was recorded at 19h. after which it decreased to a night minimum of 53° F. The barograph showed two distinct minima on the 3rd, falling from 24·84 in. at midnight to 24·82 in. at 7h. and to 24·63 in. at 15h. Remaining at that for about 30 minutes it rapidly rose to 24·73 in. while the heavy rain was falling. By 18h. 30m. it had again fallen to 24·69 in. but by 20h. 15m. had risen to 24·83 in."

Mr. Millichamp further observes that in places where pools of

water are generally left that take days to dry up, in two days after the storm just mentioned one could pass along the roads without splashing through mud.

### High Soundings with Registering Balloons and the Effects of Solar Radiation on the Temperatures Recorded

In a report to the Commission Internationale pour l'Aerostation Scientifique, held at Monaco in 1909, the late Mr. W. H. Dines contended that owing to the difficulty of avoiding the effects of solar radiation on the thermograph during the hours of daylight, the best time at which to make soundings of the upper air was just before sunset. Other councils prevailed, and to this day upper air soundings according to the international programme are for the most part made during the hours of daylight.

Authentic information as to the temperature of the atmosphere at heights between 20 and 30 Km. is of increasing general interest, and with improved balloons, soundings are now occasionally made to even greater heights. The old problem has come forward again and is brought forcibly before our notice by Herr Peregrin Zistler in a paper entitled "Hohe Registrierballonaufstiege in München und der Einfluss der Sonnenstrahlung". (*Deutsches Meteorologisches Jahrbuch für Bayern*, 1934.)

Herr Zistler has analysed the records of a large number of high soundings made at Munich during recent years with the definite object of determining quantitatively the magnitude of the thermometric error caused by instrumental lag and solar radiation. His method of attack is first to postulate an equation connecting the lag of the thermograph with the relative wind speed and the other variables; the form of the equation follows that of Jaumotte. He then develops some formulæ applicable to special cases. The meteorograph employed was the Bosch-Hergesell, which, as it includes a clock, enables the vertical velocity to be measured on both the ascent and descent of the apparatus. Since these two velocities are generally widely different, the two readings of the temperature at the same height on the ascent and descent give a fairly effective means of estimating what the recorded temperature would have been if the velocity had been so high that radiation could have been neglected. There may be differences of opinion about the absolute accuracy of some of the formulæ and their application, but they are undoubtedly of practical use in forming an estimate of the magnitude of the thermometric error, and the results carry conviction. Some graphs of temperature-height are given for cases in which the error was large, they bear a strong resemblance to many soundings made in England.

As the result of a systematic analysis of 64 high soundings made from Munich it is shown that at heights of 20 Km. and over the uncorrected readings of temperature during the daytime are too

high, while those made at night may be relied on as accurate. The mean error at 20 Km. of the ascending portions of all the soundings from Munich taken together was found to be  $2.7^{\circ}$  C. The error increases with height and is greater in summer than in winter.

In England upper air temperatures are published in the form of means of the ascending and descending record in each sounding, and it has also been customary for many years to make a partial allowance for rises of temperature which there was good reason to suppose were due to solar radiation.\* Even so, it has recently been found by an independent process that in the daytime the estimated temperatures have been too high by an amount of the same order of magnitude as that found at Munich.

One section of Herr Zistler's paper is devoted to a comparison between a series of soundings made at Uccle in the summer of 1933 by M. Jaumotte,† and some almost simultaneous soundings made from Munich. The soundings from Uccle reached great heights, and were remarkable for the pronounced negative lapse rate found in the stratosphere, and the very high temperatures at the highest levels. The comparative data are set out very fairly, the Munich soundings being analysed by the methods previously referred to. It is found that the negative lapse rate existed at Munich, but that the intensity was very much less. The abnormally high temperatures at high levels had no counterpart at Munich, and the evidence adduced points to the conclusion that some of the temperatures recorded at Uccle were affected by radiation to a serious extent.

This short paper is a very valuable contribution to the practical side of upper air work and deserves to be widely read. After reading it an irresistible feeling arises: Why do we continue to make soundings into the stratosphere during the daytime and spend long hours afterwards in trying to extract the truth from our distorted records, when by waiting till sunset indisputable data can always be obtained?

L. H. G. DINES.

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## REVIEWS

*India Meteorological Department, Memoirs, Vol. XXVI, Part IV*  
—*Discussion of Results of Sounding Balloon Ascents at Poona and Hyderabad during the period, October, 1928, to December, 1931.* By K. R. Ramanathan, D.Sc., and K. P. Ramakrishnan, B.A. The memoir is in the main a description and brief discussion of the features shown by the mean results of 78 balloon ascents at Poona, and 65 at Hyderabad (Deccan). The upper wind during the monsoon being easterly, most balloons sent up from Poona at this season

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\* London, *Meteor. Off., Obs. Yearb.* 1932, p. 439.

† Bruxelles, *Bull. Acad. R. Belg.*, Series 5, **19**, 1933, p. 1311-31. Reviewed in the *Meteorological Magazine*, 69, 1934, p. 31.

would fall into the sea. Hyderabad is free from this disadvantage, and was therefore used during the monsoon and the post-monsoon transition period. The number of ascents available varies from 5 in April and June to 23 in September. The winter months with an average of 13 ascents a month, and the monsoon, with 15 a month, are best represented.

While it cannot be expected that this small number of ascents will give normal values, and in fact there are what the authors treat as abnormalities in February which, with 15 ascents, is represented almost as well as any month, nevertheless Indian meteorologists are to be congratulated on maintaining up to date the summarising of their data. It keeps the subject alive, facilitates reference, provides a guide for future work, and makes the results available in convenient form to their colleagues in other countries.

In addition to the means, observations on a number of individual days are given, with brief notes, to illustrate the horizontal differences of temperature, and the variation of humidity with height in various types of weather.

The chief features considered are temperature, pressure, humidity and density, the tropopause, gradients between India and Batavia in relation to the wind, and the indications of tephigrams.

The maximum of temperature up to 2 dynamic kilometres (gkm.) found by the authors for April and May, was to be expected and it is natural, in view of the results obtained at Agra, to attribute the shift of the maximum from spring to the monsoon months between 5 and 15 gkm. to condensation over the Bay of Bengal and beyond. In view, however, of the later work in India on the upper circulation during the monsoon, and of the authors' subsequent conclusions, from the tephigrams, regarding the relative stability of the higher levels over Agra and the Deccan, it is at least worthy of consideration whether this slight elevation of temperature may be partly a latitude effect.

The explanation of various types of temperature change at the tropopause, suggested by J. Bjerknes, and based on meridional advection, is now applied to the explanation of the similar types found in India. The explanation seems a very probable one, and its possible contribution towards the large lapse rates encountered between 10 and 14 gkm. might usefully have been discussed. These lapse rates are attributed, on the basis of previous papers, to radiation effects, but advection effects are not specifically ruled out.

Observations made in India and Batavia, bearing on the upper currents in the intervening region, are of much interest and importance in connexion with the general circulation. If the direction of these currents is approximately uniform over the whole of the region, then the conclusions, given with regard to the upper easterly current of the monsoon and the lower north-easterly and upper westerly currents of winter and the hot season, are probably valid. If, however, the axis of the monsoon low pressure area over India, which is

inclined upwards towards the south, is situated to the north of Batavia at all levels, and if the axis of the winter high is similarly inclined, the conclusions may need to be amplified. The distance between India and Batavia is very great and additional relevant observations at other places are much to be desired.

The temptation experienced by many workers on this subject to attach significance to the indications of the hair hygrometer at temperatures below those at which, according to experimental results up to the present, the instrument is not to be trusted, has arisen again in the examination of these observations and the authors have not been able entirely to resist it. Could the facilities at the Agra Observatory and the experimental ability of Mr. Chatterjee, in combination, provide a settlement of this uncertainty once for all, a great service would have been done to meteorology. The results of the present examination in relation to humidity agree in general with previous results, and there are no exceptional features.

Tephigrams for the mean conditions shown by these ascents are found not to add much to the points raised by the preceding tables and diagrams. The utility of the tephigram is probably more marked for estimating the stability in individual cases than as applied to mean results. An item of some interest might have been added by inserting, in the diagrams, curves showing the wet bulb potential temperatures. We look forward to the future application of this conservative feature of air masses, in the country of its origin.

W. A. HARWOOD.

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- (1) *The Circulation of the Atmosphere in the Australia-New Zealand Region.* By E. Kidson. Fifth Pacific Science Congress, III, 3. (2) *Frontal Methods of Weather Analysis applied to the Australia-New Zealand Area.* By E. Kidson and J. Holmboe. Part I, Discussion; Part II, Weather Charts. Dept. of Scientific and Industrial Research, Wellington, N.Z., 1935.

The first paper contains a brief account of the general atmospheric conditions in the area mentioned. The first feature to attract attention is the regular procession of anticyclones moving eastward, the mean latitude of the centres being about  $35^{\circ}$  S. It is estimated that there are eight in the circuit of the globe, and that the circuit occupies six weeks on the average. The anticyclones are most frequently separated by troughs of low pressure, with the cyclonic centres to southward of New Zealand. The eastward movement of the pressure fluctuations or "waves" is faster than that of the surface air but much slower than that at high levels above (say) 5 kilometres at Wellington.

The second paper is an important new contribution, and combines the special knowledge of the region possessed by Dr. Kidson with the first-hand work of a representative of Bergen. Mr. J. Holmboe is one of the Bergen forecasters, and was attached to the Lincoln



Ellsworth Antarctic Expedition. He spent several months carrying out analysis at Wellington. This paper discusses four periods in detail, and 30 weather charts are reproduced in Part II. Some autographic records are shown in Part I, and also two rainfall maps illustrating very heavy rainfall in New Zealand, partly orographic.

The data available are on the scanty side, but they are supplemented by observations on Pacific Islands, and a few on ships, and some important features are brought out beyond reasonable doubt. Three of the periods illustrate families of depressions (called "waves" in the paper) affecting South Australia and New Zealand, and are stated to be typical. Thus the anticyclones are often separated by a few days of disturbed weather. These disturbed periods had many features in common with similar periods in our own area. The charts are of interest to all meteorologists, as they help to distinguish general from local features. One general feature in both temperate zones is the fact that depressions have on the average a component of motion towards the pole. In the periods discussed in the paper, the direction towards which the depressions moved varied between east and south-south-east. Another general tendency is for well developed depressions to become quickly occluded near the centre. The depressions shown here continued to move after occlusion, though usually at a reduced speed. This usually happens in our own area also, but stationary depressions are fairly common. Stationary depressions and anticyclones are unusually frequent in western Europe and the eastern Atlantic, owing to the abnormally low latitudinal temperature gradient.

The fourth period examined illustrates the development of a tropical hurricane in the South Pacific, about latitude  $20^{\circ}$  S., whose centre was encountered by S.S. "Maunganui." This developed out of one of a family of shallow depressions on a front, which formed at the northern boundary of a relatively cool SE. wind flowing round an anticyclone to eastward of New Zealand. This application of frontal analysis to a tropical cyclone is interesting and important, but it must be remembered that though there are points of similarity between cyclones in tropical and temperate latitudes, there are also marked differences. A hurricane centre may maintain itself for days in the tropics, and the only satisfactory explanation of the source of energy is the marked vertical instability for saturated air, which is known to prevail in the tropics.

C. K. M. DOUGLAS.

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### BOOKS RECEIVED

- Bulletin de l'Observatoire de Talence (Gironde)*, 3rd Series, Nos. 5-15 ; Talence, 1933, 1934 and 1935.
- Monthly Rainfall of India for 1931 and 1932*. Published by the various Provincial Governments and issued by the Meteorological Dept., Calcutta, 1933.

### OBITUARY

*John H. Bennett.*—We regret to record the death on June 18th of Mr. John H. Bennett of Ballinacurra, Co. Cork. Mr. Bennett set up a climatological station at Ballinacurra in 1904 and was thus instrumental in adding considerably to our knowledge of the climate of southern Ireland. The esteem in which Mr. Bennett was held by those who knew him is indicated by the following passage from a letter received from Miss D. Trevor McNeill:

“He was always a man of immense energy and drive, and his death is a very great loss not only to all of us in Ballinacurra but also to a very much wider section of the community for which he worked consistently and unobtrusively for a long period.”

We are glad to learn that arrangements have been made for continuing the valuable observations from Mr. Bennett's station.

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### NEWS IN BRIEF

Sir George Simpson, K.C.B., F.R.S., has been elected a Corresponding Member of the Mathematical and Physical Class of the Gesellschaft der Wissenschaften of Göttingen.

Miss D. Salter has copies of the *Meteorological Magazine* for February, 1928, to April, 1933, and of *British Rainfall*, 1927 to 1931, inclusive. Anyone wishing to purchase these should communicate direct with Miss Salter at the Bank House, Mickleton, Campden, Gloucestershire.

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### Erratum

JULY, 1935, p. 142, last line, for “the same day Saturday, June 15th” read “on Sunday, June 16th”.

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### The Weather of July, 1935

Pressure was below normal over Alaska, Canada, the United States (except the south-west), Greenland, Iceland, Spitsbergen, north Europe, western Siberia and Madeira, the greatest deficits being 7.5 mb. at Reykjavik, 4.8 mb. at Moscow and 3.2 mb. near Salt Lake City. Pressure was above normal from the east coast of the United States across western Europe to the Black Sea and the Mediterranean, the greatest excess being 5.6 mb. at Scilly. In Sweden, temperature was generally above normal except in western Norrland, and rainfall mainly deficient except in Norrland and southern Gothåland. In north and central Europe generally temperature was above normal and rainfall deficient.

The outstanding features of the weather of July over the British Isles were the widespread excess of sunshine, the continual high temperatures and in most districts the marked deficiency of rainfall. At Gorleston the total sunshine was the highest that has been recorded there for any month, and at several other stations new

records were set up for sunshine and rainfall. On the 1st a shallow depression crossed north France and the English Channel and thunderstorms accompanied by heavy rain were experienced in the Channel Islands on the morning of the 1st and in south-east England on the night of the 1st-2nd; 3.25 in. fell at Exbury (Hants), 2.23 in. at Winchester and 2.09 in. at Southampton. From then to the 5th depressions moving north-east to the north of the British Isles with associated secondaries maintained westerly winds, fresh to strong at times generally, with, in the north and west, unsettled weather but long bright periods, and elsewhere mainly dry, sunny, warm conditions; 14.6 hrs. bright sunshine occurred at Gorleston and 14.5 hrs. at Inverness and Nairn on the 1st. Mist or fog were experienced locally and on the 3rd thunderstorms in north Scotland. From the 6th to the 16th anticyclonic conditions prevailed over the whole country except occasionally in the north-west. Temperature was high during this time, reaching 90° F. at Huddersfield and 89° F. at Brighton and London on the 13th, while the record did not fall below 66° F. at Dover, Brighton and Portsmouth during the night of the 12th-13th and at Westminster during the previous night. Much sunshine was experienced most days over the whole country, among the largest amounts being 16.6 hrs. at Lerwick and 15.8 hrs. at Inverness on the 11th. The weather was mainly dry but local thunderstorms occurred in south England and the Midlands on the 11th and north England on the 14th and occasional slight rain in Scotland and Ireland. Coastal fog was experienced from the 10th-13th. From the 17th-22nd depressions passed in an easterly direction across the British Isles giving unsettled weather generally with much sunshine but some rain, heavy locally in the north and west; 3.35 in. were measured at Lerwick on the 20th and 1.73 in. at Borrowdale (Cumberland) on the 19th. Thunderstorms occurred over England generally on the 18th and in eastern England on the 20th, while the winds were often moderate to strong and temperature slightly below normal. From the 23rd-31st pressure was high over England and south Ireland, while Scotland came under the influence of depressions moving from the North Atlantic to Scandinavia until the 28th, when the high-pressure area extended north to the Faroes. Winds were mainly light or moderate, though strong locally in the north on the 25th, 27th and 28th, and there was occasional rain at first in Scotland and Ireland, but from the 29th onwards the dry sunny conditions of the south spread also to these countries. Among the largest amounts of sunshine recorded were 15.6 hrs. at Pembroke and 15.2 hrs. at Abbotsinch, both on the 29th and 30th. Temperature exceeded the average on many days in most districts, 83° F. was reached in London on the 24th, and 65° F. was the minimum temperature at Harrogate and Hull on the 27th. Slight ground frost, however, occurred at one or two places on the 30th and 31st. Mist or fog was frequent off the south-west coasts. The distribution of bright sunshine for the month was as follows:—

		Diff. from				Diff. from	
		Total	normal			Total	normal
		(hrs.)	(hrs.)			(hrs.)	(hrs.)
Stornoway	...	148	0	Chester	...	200	+40
Aberdeen	...	223	+72	Ross-on-Wye	...	257	+69
Dublin	...	215	+33	Falmouth	...	232	+11
Birr Castle	...	178	+30	Gorleston	...	309	+103
Valentia...	...	186	+28	Kew	...	272	+77

*Miscellaneous notes on weather abroad culled from various sources*

The heat experienced in northern and central Italy at the beginning of the month was abating by the 3rd (*The Times*, July 2nd).

The monsoon at first was strong in Malabar with general rains to the north and east while towards the middle of the month it was strong over Gujerat, Rajputana and Sindh with general rains to the east and south-east. By the 18th the rainfall had also extended to the Punjab. Towards the end of the month the monsoon was still active over the United Provinces, the Punjab and central India, but had weakened elsewhere. Torrential rain caused both the Yangtze and Hwang-ho rivers to rise about the 8th and 9th and serious floods resulted. Many cities were inundated; 2,000 people were reported drowned at Yenshih (Honan) and heavy loss of life occurred also in many other cities. By the 11th the floods were subsiding in western Honan but continued to increase along the lower reaches of both rivers until about the 15th; many of the dykes along the Hwang-ho gave way about this time. By the 16th the level of both rivers had started to fall but the central stream of the Hwang-ho was pouring into the Weishan Lake and the Grand Canal which overflowed its banks in Shantung the following week. By the 29th the general situation was improving with the exception of the flooded Weishan Lake area (*The Times*, July 10th-30th).

The drought in Western Queensland was broken by heavy rain over the greater part of the area affected about the 2nd and rain occurred locally in Western Australia during the first ten days but not sufficient to relieve the serious position. A severe duststorm in South Australia began on the morning of the 18th and continued during the following night. It ended with rain in the settled areas and parts of the far north where the weather had been persistently dry (*The Times*, July 3rd-20th).

Conditions were generally favourable for the crops in Canada early in the month. Tornadoes were experienced at Watford City and Ross (N. Dakota) on the 4th and a cloud-burst washed away part of the railway line near Bainville (Montana). Heavy and long-continued rain over New York State and New England on the 7th and 8th caused the deaths of 40 people and washed away bridges, while several dams burst adding greatly to the floods. Severe thunderstorms were experienced in the Ottawa Valley and at Montreal on the 16th when three people were killed, and also in New York on the 20th when four people were killed. In the United States

temperature was generally above normal during most of the month except along the Pacific Coast and in the extreme south-east, while rainfall was irregular in distribution but mainly below normal. A heat-wave was experienced in New York State during the greater part of the month and at times the humidity was also high. A tornado accompanied by hail was experienced at Montevideo on the 8th; the storm passed after six minutes but two people were killed. Drought prevailed in the Argentine during the close of the month (*The Times*, July 4th-August 2nd, and *Washington, D.C., U.S. Dept. Agric., Weekly Weather and Crop Bulletin*).

### Daily Readings at Kew Observatory, July, 1935

Date	Pressure, M.S.L. 13h.	Wind, Dir. Force 13h.	Temp.		Rel. Hum. 13h.	Rain.	Sun.	REMARKS. (see vol. 69, 1934, p. 1).
			Min.	Max.				
	mb.		°F	°F	%	in.	hrs.	
1	1012.0	NE.3	59	78	56	0.02	2.6	pr 13h. & 19h.
2	1018.0	W.3	60	72	55	1.09	8.7	tl RR 2h.-4h.
3	1025.7	SW.2	60	73	67	—	5.3	d <sub>0</sub> 7h.
4	1024.6	WSW.3	60	75	69	—	5.4	
5	1021.7	WSW.3	61	73	63	—	7.3	d <sub>0</sub> 20h. & 21h.
6	1022.6	NNW.2	56	70	51	—	13.6	
7	1024.3	E.3	52	73	52	—	13.3	w early.
8	1022.9	E.2	52	71	48	—	14.9	w early.
9	1018.0	S.2	57	80	50	—	10.6	w early.
10	1018.6	W.1	56	82	48	—	11.2	
11	1021.4	E.1	62	78	61	0.02	5.1	prt 15h.
12	1021.1	NE.2	61	81	58	0.13	4.1	pr 3h.-5h.
13	1021.0	E.3	62	85	40	—	12.9	w early.
14	1020.5	NE.2	60	85	42	—	12.9	w early.
15	1022.3	NNE.1	59	82	44	—	10.3	
16	1019.5	WNW.2	63	79	35	—	13.0	
17	1014.1	W.5	58	72	49	—	4.8	pr <sub>0</sub> 10h. 40m.
18	1009.8	W.2	55	67	73	0.21	4.5	pr 13h. & 14h. pr 16h
19	1008.3	SW.4	53	69	58	0.04	1.9	pr <sub>0</sub> 15h.-17h.
20	1002.4	SW.4	58	69	67	0.12	5.3	pr during day.
21	1021.4	WNW.3	51	68	45	—	9.2	
22	1025.7	Calm	59	73	64	—	1.8	
23	1025.4	SSE.1	58	79	57	—	8.6	w early.
24	1023.5	NNE.3	57	80	48	—	7.3	pr <sub>0</sub> 17h. 20m.
25	1023.1	NE.3	58	77	48	—	13.5	
26	1021.5	N.1	58	75	45	—	11.4	
27	1018.7	WSW.4	57	77	60	—	6.3	
28	1016.5	W.3	63	77	49	—	8.1	r <sub>0</sub> 5h.
29	1020.3	N.3	61	69	45	—	11.8	
30	1022.7	N.2	51	71	37	—	12.4	
31	1023.3	NE.2	49	72	42	—	13.6	
*	1019.7	—	58	75	52	1.63	8.8	*Means or totals.

### General Rainfall for July, 1935.

England and Wales	...	30	} per cent. of the average 1881-1915.
Scotland	...	75	
Ireland	...	36	
British Isles	...	41	

## Rainfall : July, 1935 : England and Wales

Co.	STATION.	In.	Per cent of Av.	Co.	STATION.	In.	Per cent of Av.
<i>London</i>	Camden Square.....	·90	38	<i>Leics</i>	Thornton Reservoir ...	·32	13
<i>Sur</i>	Reigate, Wray Pk. Rd...	·83	37	"	Belvoir Castle.....	·20	8
<i>Kent</i>	Tenterden, Ashenden...	·34	16	<i>Rut</i>	Ridlington .....	·66	26
"	Folkestone, Boro. San...	·27	...	<i>Lincs</i>	Boston, Skirbeck.....	·40	18
"	Eden'bdg., Falconhurst	1·60	70	"	Cranwell Aerodrome...	·67	29
"	Sevenoaks, Speldhurst.	·74	...	"	Skegness, Marine Gdns.	·69	32
<i>Sus</i>	Compton, Compton Ho.	1·50	53	"	Louth, Westgate.....	·24	9
"	Patching Farm.....	·46	19	"	Brigg, Wrawby St....	·32	...
"	Eastbourne, Wil. Sq....	·19	9	<i>Notts</i>	Worksop, Hodsock....	·50	22
"	Heathfield, Barklye....	·41	16	<i>Derby</i>	Derby, L. M. & S. Rly.	·34	14
<i>Hants</i>	Ventnor, Roy.Nat.Hos.	·22	11	"	Buxton, Terr. Slopes...	1·96	50
"	Fordingbridge, Oaklands	·56	28	<i>Ches</i>	Runcorn, Weston Pt....	·69	25
"	Ovington Rectory.....	1·34	52	<i>Lancs</i>	Manchester, Whit. Pk.	1·38	42
"	Sherborne St. John.....	·54	24	"	Stonyhurst College....	2·99	77
<i>Herts</i>	Royston, Therfield Rec.	·95	38	"	Southport, Bedford Pk.	·81	28
<i>Bucks</i>	Slough, Upton.....	1·33	69	"	Lancaster, Greg Obsy.	2·32	66
"	H. Wycombe, Flackwell	·60	30	<i>Yorks</i>	Wath-upon-Deane.....	·71	28
<i>Oxf</i>	Oxford, Mag. College...	·55	24	"	Wakefield, Clarence Pk.	·82	32
<i>Nor</i>	Wellingboro, Swanspool	·80	35	"	Oughtershaw Hall.....	4·15	...
"	Oundle .....	·42	...	"	Wetherby, Ribston H..	...	...
<i>Beds</i>	Woburn, Exptl. Farm...	·52	23	"	Hull, Pearson Park....	·22	9
<i>Cum</i>	Cambridge, Bot. Gdns.	·54	25	"	Holme-on-Spalding....	·40	15
<i>Essex</i>	Chelmsford, County Lab	1·10	52	"	West Witton, Ivy Ho.	·70	27
"	Lexden Hill House.....	·21	...	"	Felixkirk, Mt. St. John.	1·14	42
<i>Suff</i>	Haughley House.....	·56	...	"	York, Museum Gdns....	·35	14
"	Campsea Ashe.....	·78	34	"	Pickering, Hungate....	·31	12
"	Lowestoft Sec. School...	·87	38	"	Scarborough.....	·51	21
"	Bury St. Ed., Westley H.	·84	34	"	Middlesbrough.....	·48	19
<i>Norf.</i>	Wells, Holkham Hall...	·82	35	"	Baldersdale, Hury Res.	...	...
<i>Wilts</i>	Calne, Castle Walk....	1·15	...	<i>Durh</i>	Ushaw College.....	·38	14
"	Porton, W.D. Exp'l. Sta	·69	35	<i>Nor</i>	Newcastle, Town Moor.	·43	16
<i>Dor</i>	Evershot, Melbury Ho.	·53	21	"	Bellingham, Highgreen	1·15	35
"	Weymouth, Westham.	·35	19	"	Lilburn Tower Gdns....	·94	38
"	Shaftesbury, Abbey Ho.	·68	26	<i>Cumb</i>	Carlisle, Scaleby Hall...	1·70	52
<i>Devon</i>	Plymouth, The Hoe....	·38	14	"	Borrowdale, Seathwaite	7·25	92
"	Holne, Church Pk. Cott.	·51	14	"	Borrowdale, Moraine...	4·22	67
"	Teignmouth, Den Gdns.	·10	4	"	Keswick, High Hill....	1·80	47
"	Cullompton .....	·61	23	<i>West</i>	Appleby, Castle Bank...	·78	25
"	Sidmouth, U.D.C.....	·59	...	<i>Mon</i>	Abergavenny, Larchfd	·36	14
"	Barnstaple, N. Dev.Ath	1·03	38	<i>Glam</i>	Ystalyfera, Wern Ho...	2·45	53
"	Dartm'r, Cranmere Pool	1·80	...	"	Cardiff, Ely P. Stn....	·58	19
"	Okehampton, Uplands.	·87	27	"	Treherbert, Tynywaun.	2·20	...
<i>Corn</i>	Redruth, Trewirgie....	·70	23	<i>Carm</i>	Carmarthen, The Friary	·59	17
"	Penzance, Morrab Gdn.	·39	14	<i>Penb</i>	Haverfordwest, Portf'd.	...	...
"	St. Austell, Trevarna...	·59	18	<i>Card</i>	Aberystwyth .....	1·00	...
<i>Soms</i>	Cheston Mendip.....	·53	15	<i>Rad</i>	BirmW.W.Tyrmynydd	1·07	26
"	Long Ashton.....	2·04	72	<i>Mont</i>	Lake Vyrnwy .....	1·83	53
"	Street, Millfield.....	...	...	<i>Flint</i>	Sealand Aerodrome....	1·03	44
<i>Glos</i>	Blockley .....	·60	...	<i>Mer</i>	Dolgelley, Bontddu....	1·77	42
"	Cirencester, Gwynfa....	·73	28	<i>Carm</i>	Llandudno .....	·33	15
<i>Here</i>	Ross, Birchlea.....	·28	12	"	Snowdon, L. Llydaw 9.	5·23	...
<i>Salop</i>	Church Stretton.....	·67	27	<i>Ang</i>	Holyhead, Salt Island...	·33	13
"	Shifnal, Hatton Grange	·56	25	"	Lligwy .....	·33	...
<i>Staffs</i>	Market Drayt'n, Old Sp.	·48	18	<i>Isle of Man</i>			
<i>Worc</i>	Ombersley, Holt Lock.	·37	17	"	Douglas, Boro' Cem....	1·46	48
<i>War</i>	Alcester, Ragley Hall...	·51	21	<i>Guernsey</i>			
"	Birmingham, Edgbaston	·40	17	"	St. Peter P't. Grange Rd	·91	45

## Rainfall: July, 1935: Scotland and Ireland

Co.	STATION.	In.	Per cent of Av.	Co.	STATION.	In.	Per cent of Av.
Wig	Pt. William, Monreith.	...	...	Suth	Melvich.....	2.04	73
	New Luce School.....	2.45	72		Loch More, Achfary....	9.16	171
Kirk	Dalry, Glendarroch.....	...	...	Caith	Wick.....	2.61	99
	Carsphairn, Shiel.....	3.91	74	Ork	Deerness.....	3.20	125
Dumf.	Dumfries, Crichton, R.I.	1.35	44	Shet	Lerwick.....	5.76	251
	Eskdalemuir Obs.....	2.54	62	Cork	Caheragh Rectory.....	.93	...
Rozb	Bransholm.....	...	...	"	Dunmanway Rectory....	.72	18
Selk	Ettrick Manse.....	1.32	30	"	Cork, University Coll...	.50	18
Peeb	West Linton.....	1.86	...	"	Ballinacurra.....	.56	20
Berw	Marchmont House.....	1.27	42	"	Mallow, Longueville....	.86	34
E.Lot	North Berwick Res....	1.08	42	Kerry	Valentia Obsy.....	1.37	36
Midl	Edinburgh, Roy. Obs..	.62	22	"	Gearhameen.....	1.50	26
Lan	Auchtyfardle.....	1.47	...	"	Darrynane Abbey.....	1.26	33
Ayr	Kilmarnock, Kay Pk....	2.04	...	Wat	Waterford, Gortmore...	.86	27
	Girvan, Pinmore.....	2.19	60	Tip	Nenagh, Cas. Lough....	1.07	34
Renf	Glasgow, Queen's Pk...	1.86	64	"	Roscrea, Timoney Park	1.04	...
	Greenock, Prospect H..	2.29	58	"	Cashel, Ballinamona....	1.12	39
Bute	Rothsay, Ardencraig...	2.78	...	Lim	Foynes, Coolnanes.....	1.59	52
"	Dougarie Lodge.....	1.73	...	"	Castleconnel Rec.....	1.26	...
Arg	Ardgour House.....	6.93	...	Clare	Inagh, Mount Callan...	3.29	...
"	Glen Etive.....	...	...	"	Broadford, Hurdlest'n.	1.60	...
"	Oban.....	2.94	...	Wexf	Gorey, Courtown Ho...	.91	31
"	Poltalloch.....	4.88	119	Wick	Rathnew, Clonmannon..	1.07	...
"	Inveraray Castle.....	3.87	78	Carl	Hacketstown Rectory...	1.25	36
"	Islay, Eallabus.....	2.69	79	Leiz	Blandsfort House.....	1.04	33
"	Mull, Benmore.....	8.60	86	"	Mountmellick.....	.91	...
"	Tiree.....	2.17	60	Offaly	Birr Castle.....	.94	32
Kinr	Loch Leven Sluice.....	...	...	Dublin	Dublin, FitzWm. Sq....	.81	32
Perth	Loch Dhu.....	...	...	"	Balbriggan, Ardgillan..	.68	25
"	Balquhiddie, Stronvar.	1.52	...	Meath	Beauparc, St. Cloud....	.73	...
"	Crieff, Strathearn Hyd.	.89	30	"	Kells, Headfort.....	.79	25
"	Blair Castle Gardens...	.67	26	W.M.	Moate, Coolatore.....	.95	...
Angus	Kettins School.....	1.31	51	"	Mullingar, Belvedere...	.88	28
"	Pearsie House.....	1.88	...	Long	Castle Forbes Gdns.....	.78	25
"	Montrose, Sunnyside...	1.31	50	Gal	Galway, Grammar Sch.	...	...
Aber	Braemar, Bank.....	.68	26	"	Ballynahinch Castle...	3.19	77
"	Logie Coldstone Sch...	...	...	"	Ahascragh, Clonbrock.	1.03	30
"	Aberdeen, King's Coll.	2.91	103	Mayo	Blacksod Point.....	1.74	55
"	Fyvie Castle.....	2.54	78	"	Mallaranny.....	...	...
Moray	Gordon Castle.....	2.35	73	"	Westport House.....	1.02	33
"	Grantown-on-Spey.....	...	...	"	Delphi Lodge.....	5.68	86
Nairn	Nairn.....	1.29	48	Sligo	Markree Obsy.....	1.06	31
Inv's	Ben Alder Lodge.....	1.02	...	Cavan	Crossdoney, Kevit Cas.	1.06	...
"	Kingussie, The Birches	1.07	...	Ferm	Enniskillen, Portora...	...	...
"	Inverness, Culduthel R.	1.55	...	Arm	Armagh Obsy.....	1.12	39
"	Loch Quoich, Loan.....	8.47	...	Down	Fofanny Reservoir.....	1.94	...
"	Glenquoich.....	...	...	"	Seaford.....	1.22	38
"	Arisaig, Faire-na-Sguir	4.19	...	"	Donaghadee, C. Stn....	.84	30
"	Fort William, Glasdrum	...	...	"	Banbridge, Milntown...	.86	26
"	Skye, Dunvegan.....	4.04	...	Antr	Belfast, Cavehill Rd...	1.10	...
"	Barra, Skallary.....	2.72	...	"	Aldergrove Aerodrome.	1.06	38
R&C	Alness, Ardrross Castle.	1.12	37	"	Ballymena, Harryville.	1.80	52
"	Ullapool.....	2.92	92	Lon	Garvagh, Moneydig....	1.22	...
"	Achnashellach.....	7.22	140	"	Londonderry, Creggan.	1.45	40
"	Stornoway.....	2.44	81	Tyr	Omagh, Edenfel.....	1.36	40
Suth	Lairg.....	1.75	56	Don	Malin Head.....	1.89	...
"	Tongue.....	2.10	69	"	Killybegs, Rockmount.	2.55	...



## Climatological Table for the British Empire, February, 1935

STATIONS.	PRESSURE.		TEMPERATURE.						PRECIPITATION.				BRIGHT SUNSHINE.		
	Mean of Day M.S.L.	Diff. from Normal.	Absolute.		Mean Values.			Mean.	Relative Humidity.	Mean Annual In.	Diff. from Normal.	Days.	Hours per day.	Per-centage of possible.	
			Max.	Min.	Max.	Min.	1 and 2 Min.								Wet Bulb.
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	%	In.	In.				
London, Kew Obsy.....	1007.4	8.6	58	30	48.4	39.2	43.8	39.4	82	7.6	2.30	14	1.9	19	
Gibraltar.....	1021.8	1.8	67	33	61.4	45.8	53.6	45.7	78	3.5	1.29	8	...	...	
Malta.....	1015.2	0.9	64	43	58.1	50.0	54.1	49.9	79	5.8	0.89	9	6.4	59	
St. Helena.....	1011.1	0.2	74	60	71.0	62.5	66.7	63.8	91	8.2	5.74	21	...	...	
Freetown, Sierra Leone.....	1013.3	2.5	92	72	86.8	74.0	80.4	73.7	77	1.3	0.00	0	...	...	
Lagos, Nigeria.....	1010.7	1.0	91	71	87.9	76.1	82.0	76.5	89	6.0	1.24	5	6.6	55	
Kaduna, Nigeria.....	1008.9	...	98	53	93.3	58.8	76.1	56.5	43	0.7	0.00	0	...	...	
Zomba, Nyasaland.....	1010.3	2.4	83	56	77.3	62.5	69.9	64.8	77	7.9	8.98	15	...	...	
Salisbury, Rhodesia.....	1011.6	0.5	84	49	77.4	56.8	67.1	61.7	71	6.9	4.26	10	7.4	58	
Cape Town.....	1014.6	1.2	97	53	82.7	62.8	72.7	61.7	64	1.8	0.23	2	...	...	
Johannesburg.....	1012.8	1.0	82	46	74.8	53.4	64.1	56.6	75	4.9	3.66	10	7.9	61	
Mauritius.....	1009.4	1.6	88	72	84.7	74.3	79.5	77.0	89	6.9	12.76	24	7.0	55	
Calcutta, Alipore Obsy.....	1012.5	0.8	90	57	83.1	63.5	73.3	64.3	87	2.9	1.29	3*	...	...	
Bombay.....	1012.0	0.7	90	62	82.8	67.1	74.9	66.3	75	0.6	0.00	0	...	...	
Madras.....	1012.0	0.9	90	65	85.5	68.7	77.1	71.7	83	4.6	0.00	0	...	...	
Colombo, Ceylon.....	1010.9	0.1	90	69	86.8	72.1	79.5	74.6	75	5.5	2.78	6	7.6	64	
Singapore.....	1009.7	0.5	91	71	87.2	73.7	80.5	75.3	77	7.8	5.31	11	7.3	61	
Hongkong.....	1017.8	0.8	77	43	65.7	57.9	61.8	57.2	79	7.8	1.13	3	3.9	34	
Sandakan.....	1010.3	...	91	71	87.3	75.4	81.3	76.4	80	6.8	5.78	14	...	...	
Sydney, N.S.W.....	1013.5	0.4	92	52	79.1	64.8	71.9	66.2	65	6.6	3.47	7	8.6	64	
Melbourne.....	1014.8	0.3	95	50	76.7	57.4	67.1	60.3	68	6.3	3.09	13	6.7	50	
Adelaide.....	1015.9	1.7	104	48	84.1	60.1	73.9	61.1	49	5.5	0.02	2	8.8	66	
Perth, W. Australia.....	1014.0	1.0	106	49	84.5	63.2	73.9	69.8	41	3.4	0.36	7	10.1	77	
Coolgardie.....	1012.6	0.1	105	51	80.5	61.8	75.7	63.4	53	3.6	1.15	4	...	...	
Brisbane.....	1011.3	1.2	93	63	86.3	70.0	78.1	71.7	66	6.1	5.59	19	8.7	66	
Hobart, Tasmania.....	1015.1	1.9	88	46	68.8	56.0	62.4	57.0	72	7.2	4.96	18	5.5	40	
Wellington, N.Z.....	1018.5	2.7	83	49	72.4	59.0	65.7	61.5	76	7.0	3.40	9	6.3	46	
Suva, Fiji.....	1008.8	1.0	94	69	87.3	75.3	81.3	76.3	83	5.1	6.52	21	8.0	63	
Apia, Samoa.....	1008.1	0.3	88	71	85.9	74.7	80.3	76.6	79	6.3	4.24	11	7.9	63	
Kingston, Jamaica.....	1015.6	...	88	63	84.3	67.5	75.9	66.8	85	2.3	0.44	4	3.9	34	
Grenada, W.I.....	...	...	86	71	84	73	78.5	74	74	4	2.22	14	...	...	
Toronto.....	1017.5	0.5	48	-5	28.8	15.9	22.3	18.5	75	7.5	2.39	0.01	12	3.2	31
Winnipeg.....	1020.3	1.5	45	-20	26.2	5.4	10.4	10.3	...	5.2	0.15	0.59	5	4.7	47
St. John, N.B.....	1013.2	0.7	43	-11	26.6	8.9	17.7	12.4	76	6.1	3.33	13	4.6	44	
Victoria, B.C.....	1019.8	3.2	64	30	48.0	30.3	43.7	33.2	86	7.5	0.83	2.43	1	3.8	37

(27359) Wt. 18/32 1050 8/35 Hw. G.377.6

\*For Indian stations a rain day is a day on which 0.1 in. or more rain has fallen.



Winnipeg .....	1020.3	-	1.9	43	-20	20.2	8	8.9	17.7	12.2	12.4	75	6.1	3.33	-	0.57	13	4.6	44
St. John, N.B. ....	1013.2	-	0.7	43	-11	26.6	8.9	17.7	12.2	12.4	75	6.1	3.33	-	0.57	13	4.6	44	
Victoria, B.C. ....	1019.8	+	3.2	54	30	48.0	39.3	43.7	3.2	40.4	86	7.5	0.83	-	2.43	11	3.8	37	